UNIVERSITY of WISCONSIN
GREEN BAY

MEMORANDUM

TO: Kaoime Malloy, Chair
Academic Affairs Council

FROM: Scott R. Furlong, Dean
College of Liberal Arts and Sciences

DATE: January 29, 2013

SUBJECT: Request for Recommendation of Computer Science **Revised** Self Study Report

Attached for AAC review, is the Academic Program Review Self-Study Report for Computer Science reflecting revisions as recommended.

A copy of the report has also been sent to Associate Provost of Academic Affairs, Andrew Kersten. He will provide the AAC with his evaluation of the assessment plan of the unit.

I look forward to receiving the AAC's recommendation regarding this report.

Thank you.

ec: Andrew Kersten, Associate Provost for Academic Affairs
Peter Breznay, Chair Computer Science (memo only)
Cliff Abbott, Chair Information and Computer Science (memo only)

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Computer Science Program Review
Self-Study

I - Cover Sheet

Name of Program:	Computer Science
Name of Program Chair:	Peter Breznay
Date of Last Program Review:	2005
Date of Current Self-Study:	2012
Approved by ICS Executive Committee:	✓

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Section A - Mission Statement and Program Description

Mission

The following mission statement is unchanged since the beginning of the program.

The UWGB Computer Science program emphasizes the ability to design and create applications software and the need to understand the hardware and systems software resources needed to support those applications. It has this focus in part because the vast majority of students in our program are career-oriented. Many have enrolled out of high school but there are significant numbers who have been out of school for a while and are seeking a change in their current careers. Since the computing profession offers, and will continue to offer, important opportunities, computer science is an attractive option for many. We believe it important to provide them with necessary abilities to enter a computing related profession and become competent computing professionals.

The computer science program relates most strongly to the core aspect of the university's mission.

"The University of Wisconsin-Green Bay provides an interdisciplinary, problem-focused educational experience that prepares students to think critically and address complex issues in a multicultural and evolving world."

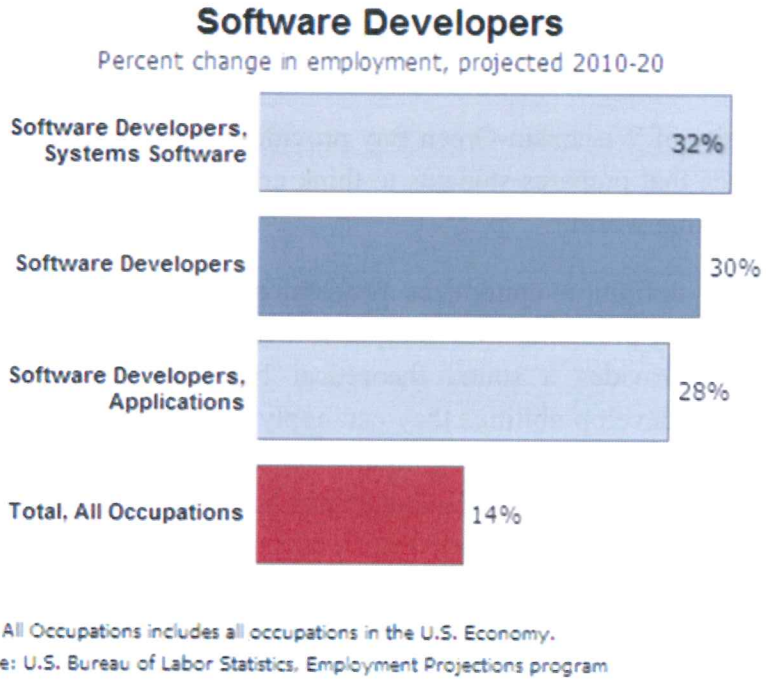
Computer Science by definition epitomizes problem solving since software development is nothing else than "solving problems with computers". In addition to preparation for computing careers, the program provides a sound theoretical base and exposure to new ideas and developments. Students develop abilities they can apply upon graduation but they must also be aware that the computing field is changing rapidly and that they must be able to adapt. A solid theoretical foundation gives them an understanding of how computers work and how to analyze the tasks specified in applications software. This is an important ingredient to software design as it gives them the tools they need to evaluate efficiency, evaluate various software design options, and to fix software that does not work. They must also see that computer science involves more than just programming and design and that there are numerous applications of computing in

many professional fields. Simply providing them with skills necessary to enter the computing profession is not sufficient. Each student must be prepared to apply what he or she has learned in order to adapt to the inevitable changes that will occur. Students must also become life-long learners with the ability to learn new ideas and apply them.

The entitlement for the Computer Science major is based on demand and recommendations of area professionals in which they stated that a computer science program is important to the university and the community. For our main category of graduates, Software Developers, the US Department of Labor's Bureau of Labor Statistics states that "Employment of software developers is projected to grow 30 percent from 2010 to 2020, much faster than the average for all occupations. The main reason for the rapid growth is a large increase in the demand for computer software."

The demand for our graduates also explains their high salaries:

"The median annual wage of applications software developers was $87,790 in May 2010. The median annual wage of systems software developers was $94,180 in May 2010."



http://www.bls.gov/ooh/computer-and-information-technology/software-developers.htm

Many of our graduates have obtained jobs that contribute significantly to the economic development of the region, at companies such as Schreiber Foods, Orion Energy Systems., Google, Inc., Visionex, U.S. Government Department of Veterans Affairs, NEW Curative Rehabilitation, Skyline Technologies, Inc.. Mountain Systems, U.S. Department of Defense, Georgia Pacific, Humana, Green Bay Packers, FuelQuest, Frozen Codebase, Fleet Farm, Fort Howard, Koehler, Integrys/Wisconsin Public Service, Acuity Insurance, Thrivent, Schneider National, Point Beach Power Plant, and others.

Computer science faculty have published in their fields, given presentations at international forums, and written computer science textbooks. They are also active in curricular development issues. The current faculty's research activities significantly support the program.

Program Description

The current catalog accurately describes the requirements and the course offerings as they were put in place in November 2011. Despite the salary advantages and the workplace demand for our graduates, student enrollment is cyclic, currently rapidly increasing. Apparently focusing only on enrollment numbers while disregarding national and international employment trends, the Dean decided that - despite the above indicated employment growth - a faculty position would be shifted from Computer Science to Communication after the retirement of Dr. William Shay.

This position re-allocation resulted in a significant reduction of course periodicities (or offering frequencies) and the elimination of some courses, such as COMP SCI 350 - Scientific Computing.

The Computer Science program currently consists of a Disciplinary and an Interdisciplinary Track. Both are popular, but the Interdisciplinary Track has turned out to be an even bigger success since its creation in 2005 than we expected. This seems to indicate that converting the Computer Science program to an entirely interdisciplinary major would make it even more attractive to students.

Most courses are taught in MAC 122, a room containing 28 workstations, 2 instructor workstations (each with its own projection system) and a document camera. Although each section is categorized as lecture in the Student Information System, the mode of instruction involves a blend of lecture, demonstration, and hands-on in class-activities. The timing and integration of these three modes of instruction varies by course and even varies within one course depending on the topics covered. Different topics require more of each type of presentation and we value the flexibility of being able to seamlessly transit from any one

mode of instruction to another. Since we moved to MAC hall in 2001, this room has allowed us to make major changes in the ways we teach most of our courses.

All CS majors are required to take a non-classroom course as part of his or her degree requirement. There are three ways to do this. Those choosing the disciplinary track must take one of:

COMP SCI 497 Internship

COMP SCI 490 Capstone Essay in Computer Science

COMP SCI 478 Senior Distinction in Computer Science.

A computer science internship typically requires that a student be involved with some programming, software design issues, database activities, or interactive web development. We will not approve an internship that involves mostly setting up a web page using html, numerous help desk activities, or a lot of software installations on workstations. While useful activities, they are not computer science. During the past five years, we've had interns work for:

Those choosing the interdisciplinary track must choose COMP SCI 490 Capstone Essay in Computer Science. For these students, the capstone will allow them to study various Computer Science and Mathematics topics and how they relate in interdisciplinary fashion.

Section B - Program Changes since Last Review

Since the last program review there have been a number of curriculum adjustments, mostly in periodicity. These are as follows:

COMP SCI 350 Scientific Computing – this course is now inactive, and is no longer be offered.

COMP SCI 352 Computer Graphics and Animation – changed from Spring of Odd years to Spring of Even years.

COMP SCI 370 Linux System Programming – changed to Every Spring semester instead of Every Fall semester.

COMP SCI 371 Advanced Object Oriented Design using C++ – changed to Every Fall semester from every semester, i.e. offered only once a year instead of every semester.

COMP SCI 351 Data Structures – periodicity changed from Every Spring to Every Fall.

The previous program review covered some actions taken as a result of our learning from alumni surveys that we were not as successful at preparing students to write software plans, program documentation, and/or project manuals. These actions have continued, particularly in the Systems Analysis and Project Management course, which had been developed to address these concerns, but also in CS 201 and CS 331.

The necessary work in adjusting to changes in the computing platforms available at UW-Green Bay has also continued since the last program review. Most recently there have been discussion with the institution's new CIO on creating special platforms for demonstrating innovations without endangering the security of the institution's computing infrastructure. These discussions will continue.

But the most significant changes since the last program review have been the personnel changes. With the death of Bruce LaPlant the program lost a very able lecturer. After a difficult search we hired Jim Hatlak as a lecturer. He struggled to adjust to the program and eventually left in the fall of 2012. He is now a dean at ITT. We currently have a search on for a replacement. Professor William Shay retired and in spring of 2012 an administrative decision was made to reallocate his position to Communication. Professor Hosung Song left at the end of the fall 2012 term to take a position with Microsoft in Seattle. The program is now making use of several ad hoc instructors to get by, something it has not done in the recent past. There are currently two faculty remaining in the program. No other four-year school in the US System has fewer than five faculty trained in computer science. The program now faces the difficulty of maintaining its high quality program with reduced staffing at the same time that there is increased interest from outside the program in making its expertise available to wider audiences, such as those in the humanities, design arts, and general education.

Section C - Program Accomplishments and Student Success

In the previous program review an argument was made that the seemingly routine work of keeping courses and the supporting technological infrastructure up to date was a significant program accomplishment and it enabled the continued student success described in Section D. Some of that work is redescribed here for specific courses.

- COMP SCI 358 Data Communications and Networks: We decided to create client programs in a Java platform (rather than C) and have them run on desktops, but keep the C programs on Linux. This formed the base of student group projects in which they created client/server applications that ran across different languages, platforms, and language paradigms. This was a significant departure from the previous project and required an exploration of issues that arose because of the cross-platform/paradigm software and a complete rewrite of the client-side part of the demos while maintaining the same server program. It also required a lot of testing and communication with Dave Kieper to make sure that the UWGB firewall permitted such cross-platform connections when running the client software from off campus. In addition, new standards in Ethernet technology, security issues, network attacks, and streaming applications needed to be included. This required learning about these new technologies and incorporating them into the course.

- COMP SCI 452 Operating Systems: This course is now completely Linux-based. We designed, created, and tested new demo programs illustrating threads, scheduling, synchronization, and I/O for a Linux environment.

- COMP SCI 370 Linux Systems: This course now covers material on writing scripts, learning the Perl language and doing some simple web applications with Perl, creating some new C programs to illustrate CGI (another kind of web application that can be used to show how search engines work), and some new client-server programming examples showing how programs on desktops can communicate with programs on a Linux server. Many new demo programs were written to illustrate these concepts.

- COMP SCI 451 Database Design and Programming: With Microsoft's move to its .NET platform, this course now uses that technology to teach the basics of database theory an programming, using the C# language in place of the earlier Visual Basic, and the SQL Server database platform instead of the earlier Microsoft Access.

- COMP SCI 352: Computer Graphics: This course focuses on the theory and implementation of creating static and dynamic graphical images and scenes to be displayed on a computer screen. Static scenes are composed of synthetically created (computer generated) objects, rendered to appear as close to photo-realistic quality as possible. Changing and moving the objects dynamically results in moving animation. The end results of the process are used in scientific visualization and data representation, in scientific modeling, in medical imaging, in education, as well as in the creation computer games, video games and digital films. The technology used in the course is based on the OpenGL (a technology that did not exist a few years ago) open source graphical application programming interfaces (graphics API), embedded in C++ programs. The course is currently undergoing a major revision due to the switch from the Borland environment to Microsoft Visual.Studio.NET. A number of technical challenges remain to be resolved, such as finding ways to incorporate an OpenGL panel into a Windows Form.

- COMP SCI 331 Internet Programming: Internet Programming (IP) is the most rapidly changing and the most technology-dependent of all Computer Science courses. Literally every semester brings new aspects and technology changes in the course. The reasons for this rapid obsolescence/update cycle are twofold: on one hand, Internet-based technologies are being created and maturing constantly and new standards are being introduced. Existing standards that are revised on a continual basis dictates a constant adaptation of the course material. Even existing and temporarily unchanged technologies change their nature in the campus environment every year, due to the constant security threats (viruses, worms, hacker attacks etc.), and the resulting pre-emptive responses by our CIT department. As a consequence of the ever-accumulating security measures and constant tightening restrictions on network access, a technology that worked last semester may not work this semester even though nothing changed in the course end. However a new security restriction blocked an access and we had to find solutions so students could create their projects. Some examples of new technology recently introduced and currently being incorporated are XML (Extensible Mark-up Language), ASP.NET, SQL Server access and ADO.NET usage in the course.

- COMP SCI 351 Data Structures: Even the so-called theory courses are affected by change. This course is a primarily theory-oriented course; however, it's also one with a strong implementation focus. In

other words students are expected not only to learn the theory presented in the class, but to use it in programmed applications. Since the programming aspect of the course is based on the C++ programming language and the use of the Standard C++/Template Library (STL), it is undergoing a major revision due to the change from the Borland IDE to Visual Studio.NET. The current version of Visual Studio.NET does not allow the combination of visual programming with the usage of the STL. As a result, a certain "intermediate" version of the course has to be worked out, in which visual representation relies on Microsoft ATL (Advanced Template Library) technology, while batch applications are based on STL. The current understanding is that in the next version of Visual Studio.NET, STL will be seamlessly incorporated (so another change will be needed).

- COMP SCI 460 Systems Analysis and Project Management. Even courses without a formal programming component are affected. This new course was developed to offer coverage for project management and systems analysis topics. In addition to learning about the supporting technologies mentioned below, we learned and taught about requirements analysis, feasibility analysis, user interface design, and a software development process (aka development methodology) such as "Rational Unified Process". We have had to learn and teach the following new technologies for this course:

1. IBM's Rational Rose - for UML & Use Case Modeling.

2. Microsoft's Visio - for traditional process modeling (data flow diagrams & functional decomposition diagrams).

3. Microsoft's MS Project - for Project Management.

4. IBM's Rational Software Architect - a product that replaces Rational Rose for UML & Use Case Modeling. This product will be used fall 2005 instead of "Rational Rose".

In addition to all of this, some of us did not even know the Java and C++ languages a few years ago, let alone how to develop software using the object oriented paradigm. Languages and standards such as VB .NET, ADO .NET, OPENGL, ASP .NET, Visual Studio .NET did not even exist several years ago – yet students and employers expect they are part of the curriculum. There's no doubt there are things that do not exist now that will become a standard part of the CS curriculum in a few years. There's no reason to think things will change.

An important final comment on learning new technologies: It's important to recognize that employees in any technology department are sent to numerous (and very expensive) training courses to update their

knowledge in response to new technologies. It's an expected part of their job. Yet, we have to do it on our own!!!

Section D - Program Enrollment Trends and Analysis

The program considered four issues in enrollment trends: overall enrollments, the gender imbalance, the graduation rate, and the success rate of graduates.

Past history has shown overall enrollments to be fairly cyclic, correlating with the emergence of technological breakthroughs. In the last six years the number of major generally fell reaching a low in 2010 and then rose in the last two years. In the fall of 2012 the number reached its highest point for the six year period with 103 majors.

The gender imbalance has been noted in reactions to earlier program reviews. It is real and persistent. It is in our students. It is in our faculty. It is in the field nationally. The Office of Institutional Research helped us by collecting and analyzing some data. Because the numbers at UW-Green Bay are so low, it is not reasonable to make meaningful assessments. A single female graduate in a year is enough to put us above some national and state rates. We have no special insight into a solution for the gender imbalance.

The graduation rate has been seen in some quarters as a problem. Our faculty, however, see the rigor and quality of the program as leading to a high attrition rate of about 80%. This means that out of every five declared majors four choose another major (often Information Science) once they realize that they are not up to the demanding standards of the field. This rate, however, is not cause for concern. Rather it is a badge of honor. The Office of Institutional Research did a study contrasting Computer Science and Communications students using data from 2003 to 2008. Students were chosen who were equally invested in their programs as measured by completion of at least 12 credits of supporting courses. There was not a significant difference in final GPAs between the two groups but there was a significant different in graduation rate, both in leaving GB and in leaving the program for another at GB. Other analysis showed the general attrition funnel from application through admission to enrollment and declaration of major to be as expected with one exception. The attrition rate of women (this requires about a decade's worth

of data to see a trend) who had done well in supporting courses was much higher than the rate for men.

The data supplied to the program demonstrate, although with a fairly low n, a high rate of graduate success. As a result of our high standards, our graduates find employment in their fields and occupy the highest levels of salary rank and their education is closely related to their jobs.

Table 7. Current employment status	COMP SCI (n = 8)	UWGB (n = 978)
Employed full-time (33 or more hours/week)	100%	80%
Employed part-time	0	11%
Unemployed, seeking work	0	4%
Unemployed, not seeking work	0	1%
Student, not seeking work	0	4%

Table 8. Satisfaction with current job (5-pt. scale; 5 = very satisfied)	Unit of Analysis	n	Very satisfied or satisfied	mean
2007-2011 percentage	COM SC	8	88%	4.4
	UWGB	886	76%	4.0

Table 10. Extent to which job relates to major	COMP SCI (n = 8)	UWGB (n = 885)
Very related	88%	53%
Somewhat related	12%	29%
Not at all related	0	18%

Table 11. Current income	COMP SCI (n = 7)	UWGB (n = 856)
Under $20,000	0	12%
$20,000 to $25,999	0	11%
$26,000 to $29,999	0	8%
$30,000 to $35,999	0	23%
$36,000 to $39,999	0	11%
$40,000 to $49,999	43%	18%
$50,000 or more	57%	17%

With data like these we are confident that the job satisfaction, excellent employment prospects and high salaries of our graduates speak for our success more than any phony narrative emanating from mass-production majors possibly could for theirs.

Section E – Conclusion and Vision for Future Development

The Computer Science program is currently coping with severely compromised staffing due to the retirement of Professor Bill Shay, the loss of its fulltime lecturer (Jim Hatlak) late in September 2012 and the imminent loss of Professor Song in January 2013. There remain just two faculty – Professors Baulieu and Breznay. Rather than a wish list of what the remaining faculty should or would like to do, we present in this section some possible futures to explore. There is a current search to replace Jim Hatlak with either an Assistant Professor or Lecturer and a proposal to hire a one year visiting position for 2013-14 to cover Professor Song's courses while the future of Computer Science can be planned. The strategy is to continue the long-standing policy in our program of hiring generalists in Computer Science (with the ability to teach much of the courses in the core curriculum) with an interest in developing expertise in areas complementing our current curriculum. Thus new hires would help direct the future of the program.

The title of the program "Computer Science" is a constraining factor. Computer Science is a well-defined and well-understood field of study. The Association for Computing Machinery (ACM) is the professional organization in Computer Science and determines appropriate core knowledge bases and skill sets to be expected from any undergraduate program in Computer Science. No undergraduate program lacking significant portions of this core can legitimately call itself Computer Science. Programs with titles such as computational studies, computer technology, digital studies, technology support systems, and the like are not so constrained and tend to be entirely different animals.

Possible future #1 – eliminate the Computer Science program

This would be the cheapest option, but also the most damaging to UW-Green Bay and the region. In an era where computing technology is ubiquitous, there is a need, documented by the Bureau of Labor Statistics, for a variety of positions requiring legitimate Computer Science degrees. Positions appropriate for Computer Science graduates are often filled, unsatisfactorily, by graduates with closely related degrees because the region, state, and nation cannot meet the demand for Computer Science graduates. The options of eliminating the major and just offering a minor in Computer Science or replacing it with a less rigorous program in computational studies or technology support do not have the support of the current faculty.

Possible future #2 – tweaking the status quo

Assuming the recovery of four full-time faculty positions, we can choose to continue the current productive and well-regarded program and monitor for small changes to accommodate student demand, changes in technology, and the search for continuous improvement. Enrollment in the program is on the

rise, following a cyclic pattern forecast by a number of studies. Feedback from regional employers shows praise the quality of our graduates. Minimal staffing, however, limits much programmatic change and encourages a crisis mentality not conducive to strategic planning. In recent months current majors have questioned faculty about the future of the program and its viability with so few faculty. This concern has been echoed by prospective students and their parents during Preview Days. Such concern could derail the expected increase in enrollment.

Given these constraints, a number of curricular changes have been discussed. Changes in the lower level curriculum might provide multiple access points for prospective majors and for general education. Possible new courses include "Overview of Computing," "Introduction to Programming," and "Introduction to Web Design." Staffing constraints mean that anything new requires giving something up. Possibilities that have been discussed include streamlining the discrete math sequence of two courses into one, combining material from CS 371 Advanced Object-Oriented Design Using C++ and CS 370 Linux Systems Programming, and the elimination of CS 350 Scientific Computing. Two strategies the program has used in the past to accommodate change have been to more specific content from one course to another and to increase or limit options for students in meeting program requirements. An example of the former is parceling out material in Discrete Math into other courses. An example of the latter is plans to move CS 331 Internet Programming and CS 451 Database Design from more optional to more required elements of the program. Another strategy for adaptation is to broaden the content of a particular course. Currently there are plans to broaden CS 464 Artificial Neural Networks to a more general course on Artificial Intelligence.

Descriptions of possible new courses and changes:

"Overview of Computing" type course provides a review of the main ideas, goals and history of computing, the various branches and sub-fields within computing and presents an overview of current trends and emerging platforms. Ideally it would be offered every semester, as a General Education "computer literacy" course. This is a non-programming course, aiming at breadth, overview and attracting interest in the field.

"Introduction to Programming" type course. The focus is on providing an introductory coverage of the most important procedural programming constructs (sequential, conditional and iterative control flow, basic binary arithmetic and number representation, strings, arrays and interactive GUI controls; the elements of relational database theory, without normalization, and the basics of SQL). The programming language is to be determined (currently JavaScript). Offered for every incoming COMP SCI and INFO SCI major and minor, ideally every Spring semester. The numbering of the course (156) is a reference to being an introduction to COMP SCI 256: Software

Design I. No object-oriented concepts need to be introduced at this level. Pre-requisite of 256 is 156 or equivalent knowledge.

"Introduction to Web Design" type course covers HTML and CSS (Cascading Style Sheets) and client-side scripting (most likely in JavaScript). Also deals with design issues, aesthetics, target audience and market analysis, user friendliness, web site structure, compliance with standards, internationalization and handicapped-access regulation. The course number (231) is a reference to being a prerequisite of COMP SCI 331: Internet Programming that deals primarily with server-side scripting and programming and data-driven web site construction. Prerequisite of 331 is 231 or equivalent knowledge. This also can be considered for being offered as a General Education course.

We also need to work on keeping up with accelerating changes in technology, in particular introducing subjects dealing with mobile computing and mobile app development, social networking, cloud computing, new Internet technologies and new computing platforms (such as Android) as well as new programming languages. In this respect we have to deal with a host of new programming languages (Python, PHP, Ruby, Ruby on Rails, JQuery, Dart etc.) and platforms (Android, iOS, Windows Mobile etc.). In this situation on-the-fly innovation and language/platform experimentation by faculty need to be accepted and encouraged.

We are also discussing ways of condensing COMP SCI 241 and 242 (Discrete Math I and Discrete Math II) into possibly a single one-semester, 4 credit course (under the name of Discrete Mathematics or Discrete Computational Structures or similar). The primary direction is reducing linear algebra to the necessary minimum (concepts and operations with vectors and matrices, their visualization, the concepts of dot product, norm, symmetric and invertible matrices, determinants and their use in solving linear systems of equations), paring down logic similarly (to basic digital/Boolean logic, gates, digital logic laws like De Morgan's identities etc., calculation with logical values), also reducing the discussion of number systems and representations and graph theory (covering only the basics). The primary areas that need reduction are the ones that (1) can and are dealt with elsewhere (just as number representation and digital logic in Computer Architecture, binary and other search trees in Data Structures) and (2) are algorithmic in nature (searching and sorting, tree traversals, graph algorithms), because these are also dealt with elsewhere (primarily in Data Structures and in Theory of Algorithms). Also minimized would be the coverage of automata and formal language theory. This change

relieves 4 credits towards the above mentioned change of Internet Programming and Databases being converted to required courses.

The program would also like to expand its internship program. Whether that is a matter of tweaking the status quo or dependent on additional staffing depends of the extent of anticipated expansion.

Option #3 – expand the tracks

Computer Science currently supports two tracks: an interdisciplinary track that essentially combines the fields of computer science and mathematics and prepares students well for graduate study; and a disciplinary track designed to meet ACM standards and prepare students for entry level positions requiring computer scientists. Students wishing a solid core of computing along with a focus for a more particular career area are now well served by this design. Too many students enroll in the interdisciplinary track only to discover it is very challenging and then they change their major. Some focused areas in the field have endured while others have become obsolete or have proven to be short-term fads, so caution is warranted in expanding tracks. Here are a number of possible tracks or focus areas that might be developed:

Data analytics: data mining, data warehousing, statistics, market research

Data Management/Management Information Systems/Business Intelligence: systems analysis, project management, enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM)

Information Technology: cloud computing, parallel processing, mobile computing, security

Game design: computer graphics, artificial intelligence, mobile computing, app design

Internet Programming/Digital and Web Design: social networking, databases, scripting languages, e-commerce, technical writing, digital humanities

Mobile computing: app design

Traditional/Theoretical (the current tracks)

The development of this option and the particular configuration of any of the above possible track expansions is dependent on two important factors. One is available staffing and the other is relations with other programs. There are several possible approaches to the staffing issue. One is to hire faculty with targeted expertise in the area of the expanded tracks. This is the typical strategy of larger programs and is risky for a smaller program since a large investment in narrow expertise may threaten the programs core

curriculum. Another approach is to hire generalists with side interest in developing the expanded tracks or generalists with enough redundancy in the core curriculum so that several faculty could develop side interests in the expanded tracks. This approach is closest to what the program has done in the past. A third approach is hire on an ad hoc basis for specific courses needed in the expanded tracks. This approach depends on developing a network of connections with people with the specialized expertise willing to teach. The current staff has been making some efforts in this direction both with UW-Green Bay graduates who have gone on to acquire the expertise and with current GB employees who may use it in their jobs here. A few people have already been involved in our program as guest lecturers.

The other factor is relationships with other programs (Business Administration, Information Sciences, Communication, Mathematics, Design Arts, Humanistic Studies). What we are imagining here is a collaborative curriculum. A natural partner for some of the tracks would be Business but that relationship is severely constrained by accreditation aspirations. The Information Science program is another natural partner but the future of that program is in jeopardy due to its own staffing problems. It is conceivable that the current IS curriculum could be displaced by an expanded version of tracks in Computer Science, but it is hard to imagine without additional staffing. The current IS program is essentially a collaboration of Communication with Computer Science but the needs of Communication and the recent decision by the administration to reallocate Bill Shay's position in Computer Science to Communication make IS a feeble collaborator. Whether new faculty being hired in Communication can strengthen IS remains to be seen. The Mathematics program is already a partner with Computer Science. The collaboration there is the basis for the current interdisciplinary track in Computer Science. There have been students who have double majored in CS and Design Arts and it may be fruitful to explore whether a shared program might be more efficient for students than a double major. There is also interest in a digital humanities program that is awaiting more investigation and development.

The future of Computer Science is not entirely in its own hands. To do appropriate planning for the future it needs a signal about what kind of Computer Science the institution is willing and able to support.

III Required Attachments

1. *Tables supplied by Office of Institutional Research and Assessment*

Alumni Surveys: 2007, 2008, 2009, 2010 & 2011

	Survey year	Graduation Year	Computer Science	UWGB Overall
Graduates:	2007	2003-2004	20	1059
	2008	2004-2005	14	1086
	2009	2004-2006	13	1087
	2010	2006-2007	18	1147
	2011	2007-2008	16	1161
Response Rate*	2007-2011		8/81 (10%)	988/5540 (18%)

* Note: % response misses double-majors who chose to report on their other major.

Table 1. Preparation & Importance Preparation by UWGB (5-pt. scale; 5 = excellent) Importance to current job or graduate program (5-pt. scale; 5 = very important)	Unit of Analysis	2007-2011					
		Preparation			Importance		
		n	Excellent or Good	Mean	n	Very important or Important	Mean
Critical analysis skills.	COM SC	8	63%	3.6	8	100%	4.8
	UWGB	781	67%	3.8	744	91%	4.5
Problem-solving skills.	COM SC	8	63%	3.6	8	100%	4.8
	UWGB	787	69%	3.8	743	93%	4.7
Understanding biology and the physical sciences.	COM SC	7	29%	3.3	7	14%	1.7
	UWGB	750	48%	3.4	726	28%	2.6
Understanding the impact of science and technology.	COM SC	8	25%	3.1	8	88%	4.4
	UWGB	753	50%	3.5	734	45%	3.2
Understanding social, political, geographic, and economic structures.	COM SC	7	43%	3.4	7	0	1.9
	UWGB	774	59%	3.6	740	55%	3.5
Understanding the impact of social institutions and values.	COM SC	7	57%	3.4	7	0	2.1
	UWGB	773	67%	3.8	739	64%	3.7
Understanding the significance of major events in Western civilization.	COM SC	7	43%	3.4	7	0	1.9
	UWGB	766	51%	3.5	738	29%	2.6

Table 1. Preparation & Importance Preparation by UWGB (5-pt. scale; 5 = excellent) Importance to current job or graduate program (5-pt. scale; 5 = very important)	Unit of Analysis	2007-2011					
		Preparation			Importance		
		n	Excellent or Good	Mean	n	Very important or Important	Mean
Understanding a range of literature.	COM SC	7	57%	3.7	7	0	1.9
	UWGB	764	50%	3.4	729	31%	2.7
Understanding the role of the humanities in identifying and clarifying individual and social values.	COM SC	7	43%	3.4	7	14%	2.4
	UWGB	755	57%	3.6	721	38%	3.0
Understanding at least one Fine Art, including its nature and function(s).	COM SC	7	43%	3.3	7	0	1.3
	UWGB	769	63%	3.7	725	28%	2.6
Understanding contemporary global issues.	COM SC	7	57%	3.4	7	14%	2.0
	UWGB	757	56%	3.6	724	51%	3.4
Understanding the causes and effects of stereotyping and racism.	COM SC	7	29%	2.7	7	14%	2.4
	UWGB	761	62%	3.7	728	59%	3.6
Written communication skills.	COM SC	7	57%	3.9	8	88%	4.5
	UWGB	776	79%	4.1	734	91%	4.6
Public speaking and presentation skills.	COM SC	7	29%	3.1	8	75%	4.3
	UWGB	769	62%	3.7	736	85%	4.4

Table 1. Preparation & Importance

Preparation by UWGB (5-pt. scale; 5 = excellent)

Importance to current job or graduate program (5-pt. scale; 5 = very important)

	Unit of Analysis	2007-2011					
		Preparation			Importance		
		n	Excellent or Good	Mean	n	Very important or Important	Mean
Reading skills.	COM SC	7	57%	3.6	8	75%	4.3
	UWGB	769	73%	4.0	727	91%	4.5
Listening skills.	COM SC	7	43%	3.6	8	100%	4.9
	UWGB	769	74%	4.0	727	96%	4.7
Leadership and management skills.	COM SC	7	57%	3.3	8	100%	4.8
	UWGB	770	65%	3.8	727	93%	4.7

Table 2. Educational experiences

(5-pt. scale; 5 = strongly agree)

	Unit of Analysis	N	Strongly Agree or Agree	Mean
My educational experiences at UW-Green Bay helped me to learn or reinforced my belief that learning is a lifelong process.	COM SC	8	75%	4.0
	UWGB	984	93%	4.4
While at UW-Green Bay, I had frequent interactions with people from different countries or cultural backgrounds than my own.	COM SC	8	50%	3.6
	UWGB	979	52%	3.4

Table 2. Educational experiences (5-pt. scale; 5 = strongly agree)	Unit of Analysis	N	Strongly Agree or Agree	Mean
Students at UW-Green Bay are encouraged to become involved in community affairs.	COM SC	8	38%	3.3
	UWGB	965	58%	3.6
My experiences and course work at UW-Green Bay encouraged me to think creatively and innovatively.	COM SC	8	75%	4.1
	UWGB	983	88%	4.2
The interdisciplinary, problem-focused education provided by UW-Green Bay gives its graduates an advantage when they are seeking employment or applying to graduate school.	COM SC	8	75%	3.6
	UWGB	975	77%	4.0
UW-Green Bay provides a strong, interdisciplinary, problem-focused education.	COM SC	8	75%	3.8
	UWGB	979	83%	4.1
Students at UW-Green Bay have many opportunities in their classes to apply their learning to real situations.	COM SC	8	50%	3.4
	UWGB	978	72%	3.9
I would recommend UW-Green Bay to co-worker, friend, or family member.	COM SC	8	88%	3.9
	UWGB	984	89%	4.3
The General Education requirements at UWGB were a valuable component of my education.	COM SC	8	38%	3.1
	UWGB	936	60%	3.6
UWGB cares about its graduates.	COM SC	8	75%	3.8
	UWGB	951	61%	3.7

Table 2. Educational experiences (5-pt. scale; 5 = strongly agree)	Unit of Analysis	N	Strongly Agree or Agree	Mean
I feel connected to UWGB.	COM SC	7	57%	3.7
	UWGB	971	47%	3.3

Table 3. "If you could start college over"	Unit of Analysis	n	UW-Green Bay		Another college		No bachelor's degree anywhere
			Same major	Different major	Same major	Different major	
2007–2011 percent	COM SC	8	63%	0	37%	0	0
	UWGB	979	63%	23%	8%	5%	1%

Table 4. Rating the MAJOR (Scale: A = 4, B = 3, etc.)	Unit of Analysis	2007–2011			
		n	A or B	C or D	mean
Quality of teaching.	COM SC	8	88%	12%	3.4
	UWGB	983	95%	5%	3.5
Knowledge and expertise of the faculty.	COM SC	8	100%	0	3.6

	UWGB	985	98%	2%	3.7
Faculty-student relationships (e.g., helpfulness, sensitivity, acceptance of different views).	COM SC	8	88%	12%	3.4
	UWGB	983	90%	9%	3.5
Importance and relevance of courses to professional and academic goals.	COM SC	8	88%	12%	3.4
	UWGB	974	89%	11%	3.4
Advising by faculty (e.g., accuracy of information).	COM SC	8	100%	0	3.5
	UWGB	966	86%	13%	3.3
Availability of faculty (e.g., during office hours).	COM SC	8	100%	0	3.5
	UWGB	972	93%	6%	3.5
Overall grade for the major (not a sum of the above).	COM SC	8	100%	0	3.4
	UWGB	976	93%	6%	3.5

Table 5. Highest degree planned	Unit of Analysis	n	Bachelor's	Master's	Specialist	Professional	Doctoral
2007-2011 percent	COM SC	8	63%	25%	0	0	12%
	UWGB	976	35%	47%	2%	5%	11%

Table 6. Graduate/professional study plans	Unit of Analysis	n	Already graduated	Currently enrolled	Accepted, not enrolled	Rejected	Have not applied
2007-2011 percent	COM SC	3	33%	0	0	0	67%
	UWGB	668	19%	23%	4%	3%	50%

Table 7. Current employment status	COMP SCI (n = 8)	UWGB (n = 978)
Employed full-time (33 or more hours/week)	100%	80%
Employed part-time	0	11%
Unemployed, seeking work	0	4%
Unemployed, not seeking work	0	1%
Student, not seeking work	0	4%

Table 8. Satisfaction with current job (5-pt. scale; 5 = very satisfied)	Unit of Analysis	n	Very satisfied or satisfied	mean
2007-2011 percentage	COM SC	8	88%	4.4

	UWGB	886	76%	4.0

Table 9. Minimum educational requirements for current job	COMP SCI (n = 8)	UWGB (n = 881)
High school or less	0	17%
Certificate	12%	3%
Associate's degree	0	15%
Bachelor's degree	88%	58%
Graduate degree	0	7%

Table 10. Extent to which job relates to major	COMP SCI (n = 8)	UWGB (n = 885)
Very related	88%	53%
Somewhat related	12%	29%
Not at all related	0	18%

Table 11. Current income	COMP SCI (n = 7)	UWGB (n = 856)

Under $20,000	0	12%
$20,000 to $25,999	0	11%
$26,000 to $29,999	0	8%
$30,000 to $35,999	0	23%
$36,000 to $39,999	0	11%
$40,000 to $49,999	43%	18%
$50,000 or more	57%	17%

Employers, Locations, and Job Titles

Wisconsin			
Schreiber Foods, Inc	Green Bay	Wisconsin	Senior Software Engineer
Foley & Lardner, LLP	Milwaukee	Wisconsin	Help Desk Analyst II
Integrys Business Support	Green Bay	Wisconsin	Associate Program Analyst
Lockheed Martin	Huntsville	Alabama	Senior Software Engineer
Acuity Insurance	Sheboygan	Wisconsin	Programmer/Analyst
Alliance Laundry Systems	Ripon	Wisconsin	Web Developer

Compuware	Appleton	Wisconsin	Consultant-Computer Programmer

Graduating Senior Surveys: 2007, 2008, 2009, 2010 & 2011

	Graduation Year	Computer Science	UWGB Overall
Graduates:	2007	17	978
	2008	14	979
	2009	8	1050
	2010	7	1096
	2011	13	1180
Response Rate*	2007-2011	32/59 (54%)	2981/5283 (56%)

* Note: % response misses double-majors who choose to report on their other major.

Table 1: Rating the MAJOR (A = 4, B = 3.0, etc.)	Unit of Analysis	2007-2011						
		N	mean	A	B	C	D	F
Clarity of major requirements	COM SC	32	3.4	53%	38%	6%	0	3%
	UWGB	2975	3.4	54%	37%	7%	2%	<1%

Table 1: Rating the MAJOR (A = 4, B = 3.0, etc.)	Unit of Analysis	2007-2011						
		N	mean	A	B	C	D	F
Reasonableness of major requirements	COM SC	32	3.3	38%	59%	3%	0	0
	UWGB	2969	3.4	52%	39%	7%	1%	<1%
Variety of courses available in your major	COM SC	31	2.9	29%	42%	23%	6%	0
	UWGB	2948	2.9	28%	42%	23%	6%	1%
Frequency of course offerings in your major	COM SC	32	2.3	6%	37%	41%	16%	0
	UWGB	2955	2.5	16%	39%	32%	10%	3%
Times courses were offered	COM SC	30	2.9	30%	40%	23%	7%	0
	UWGB	2907	2.8	23%	41%	27%	7%	2%
Quality of internship, practicum, or field experience	COM SC	27	3.6	78%	15%	4%	0	3%
	UWGB	1696	3.3	57%	28%	10%	3%	2%
Quality of teaching by faculty in your major	COM SC	32	3.1	25%	66%	6%	3%	0
	UWGB	2957	3.4	50%	40%	8%	1%	1%
Knowledge and expertise of the faculty in your major	COM SC	32	3.3	38%	53%	6%	3%	0
	UWGB	2969	3.6	68%	28%	4%	<1%	<1%
Faculty encouragement of your educational goals	COM SC	31	3.4	52%	39%	6%	0	3%
	UWGB	2940	3.3	53%	32%	11%	3%	1%
Overall quality of advising received	COM SC	31	3.3	58%	19%	19%	0	3%

Table 1: Rating the MAJOR (A = 4, B = 3.0, etc.)	Unit of Analysis	2007-2011						
		N	mean	A	B	C	D	F
from the faculty in your major	UWGB	2816	3.1	50%	27%	13%	6%	4%
Availability of your major advisor for advising	COM SC	32	3.5	63%	28%	6%	3%	0
	UWGB	2809	3.3	56%	27%	11%	4%	2%
Ability of your advisor to answer university questions	COM SC	31	3.5	68%	23%	6%	0	3%
	UWGB	2770	3.4	61%	24%	9%	3%	3%
Ability of your advisor to answer career questions	COM SC	28	3.4	68%	14%	14%	0	4%
	UWGB	2545	3.2	49%	29%	14%	4%	4%
In-class faculty-student interaction	COM SC	32	3.5	59%	34%	6%	0	0
	UWGB	2889	3.4	54%	37%	8%	1%	<1%
Overall grade for your major (not an average of the above)	COM SC	31	3.1	29%	58%	10%	3%	0
	UWGB	2930	3.3	44%	47%	8%	1%	<1%

Table 2. Job related to major while completing degree?	Unit of Analysis	n	Full-time		Part-time		No
			Paid	Non-paid	Paid	Non-paid	
2007-2011 percent	COM SC	32	22%	3%	53%	0	22%
	UWGB	2964	12%	<1%	34%	6%	48%

Table 3. "If you could start college over"	Unit of Analysis	n	UW-Green Bay		Another college		No BA degree
			Same major	Different major	Same major	Different major	
2007-2011 percent	COM SC	32	75%	0	25%	0	0
	UWGB	2959	68%	12%	14%	5%	1%

Table 4. Plans regarding graduate/professional study	Unit of Analysis	n	Already admitted	Have applied	Plan to eventually attend	NA/have not applied yet
2007-2011 percent	COM SC	20	5%	5%	65%	25%
	UWGB	2248	7%	12%	68%	13%

Table 5. Highest degree planned	Unit of Analysis	n	Bachelor's	Master's	Specialist's	Professional	Doctoral
2007-2011 percent	COM SC	32	50%	41%	0	0	9%
	UWGB	2964	29%	52%	1%	5%	13%

Table 6. General Education preparation Current proficiency vs. Contribution of Gen Ed to current proficiency (3-pt. scale; 3 = high, 2 = medium, 1 = low)	Unit of Analysis	Current Proficiency			Gen Ed Contribution		
		n	% High	mean	n	% High	mean
Critical analysis skills.	COM SC	28	75%	2.8	28	32%	1.9
	UWGB	2754	66%	2.7	2676	24%	2.0
Problem-solving skills.	COM SC	28	82%	2.8	28	29%	1.8
	UWGB	2750	71%	2.7	2670	24%	2.0
Understanding biology and the physical sciences.	COM SC	28	32%	2.2	28	21%	1.9
	UWGB	2737	25%	2.0	2565	25%	2.0
Understanding the impact of science and technology.	COM SC	28	79%	2.8	27	26%	1.9
	UWGB	2728	34%	2.2	2566	22%	2.0
Understanding social, political, geographic, and economic structures.	COM SC	28	29%	2.1	29	17%	1.9
	UWGB	2728	33%	2.2	2621	26%	2.0
Understanding the impact of social institutions and values.	COM SC	28	21%	2.0	29	7%	1.8
	UWGB	2737	52%	2.5	2643	33%	2.2
Understanding the significance of major events in Western civilization.	COM SC	28	21%	2.0	28	25%	2.1
	UWGB	2728	32%	2.2	2608	29%	2.1

Table 6. General Education preparation

Current proficiency vs. Contribution of Gen Ed to current proficiency

(3-pt. scale; 3 = high, 2 = medium, 1 = low)

	Unit of Analysis	Current Proficiency			Gen Ed Contribution		
		n	% High	mean	n	% High	mean
Understanding the role of the humanities in identifying and clarifying values.	COM SC	28	21%	2.0	29	14%	1.9
	UWGB	2736	36%	2.2	2623	29%	2.1
Understanding at least one Fine Art.	COM SC	28	25%	2.0	28	39%	2.1
	UWGB	2735	39%	2.2	2607	31%	2.0
Understanding contemporary global issues.	COM SC	28	32%	2.2	28	18%	1.9
	UWGB	2725	34%	2.2	2603	22%	2.0
Understanding the causes and effects of stereotyping and racism.	COM SC	28	39%	2.3	27	19%	1.9
	UWGB	2739	63%	2.6	2642	34%	2.1
Written communication skills	COM SC	28	46%	2.4	29	28%	2.0
	UWGB	2747	65%	2.6	2689	37%	2.2
Public speaking and presentation skills	COM SC	28	29%	2.1	27	26%	1.8
	UWGB	2737	45%	2.3	2619	27%	2.0
Computer skills	COM SC	27	96%	3.0	28	29%	1.8
	UWGB	2732	56%	2.5	2558	22%	1.9

Table 7. Educational experiences (5 pt. scale; 5 = strongly agree)	Unit of Analysis	2007-2011		
		n	Strongly Agree or Agree	mean
Because of my educational experiences at UW-Green Bay, I have learned to view learning as a lifelong process.	COM SC	30	87%	4.3
	UWGB	2888	91%	4.4
While at UW-Green Bay, I had frequent interactions with people from different countries or cultural backgrounds than my own.	COM SC	30	47%	3.2
	UWGB	2821	40%	3.1
The UW-Green Bay educational experience encourages students to become involved in community affairs.	COM SC	30	30%	3.1
	UWGB	2780	50%	3.4
My experiences at UW-Green Bay encouraged me to think creatively and innovatively.	COM SC	30	70%	3.8
	UWGB	2889	81%	4.0
My education at UW-Green Bay has given me a "competitive edge" over graduates from other institutions.	COM SC	27	44%	3.2
	UWGB	2734	59%	3.7
UW-Green Bay provides a strong, interdisciplinary, problem-focused education.	COM SC	29	52%	3.5
	UWGB	2840	71%	3.9
Students at UW-Green Bay have many opportunities in their classes to apply their learning to real situations.	COM SC	29	45%	3.2
	UWGB	2866	69%	3.8
I would recommend UW-Green Bay to a friend, co-worker, or family member.	COM SC	30	67%	3.7
	UWGB	2876	81%	4.1

Table 7. Educational experiences

(5 pt. scale; 5 = strongly agree)

	Unit of Analysis	2007-2011		
		n	Strongly Agree or Agree	mean
There is a strong commitment to racial harmony on this campus.	COM SC	29	59%	3.5
	UWGB	2650	55%	3.6
The faculty and staff of UWGB are committed to gender equity.	COM SC	28	82%	4.0
	UWGB	2732	74%	4.0
This institution shows concern for students as individuals.	COM SC	29	62%	3.7
	UWGB	2848	74%	3.9
The General Education requirements at UWGB were a valuable component of my education.	COM SC	29	31%	2.6
	UWGB	2726	46%	3.2

Table 8. Activities while at UW-Green Bay

	Unit of Analysis	n	Independent study	Student org	Internship	Professional	Community	Worked with a faculty member	Study group	Study abroad
2007-2011 percent	COM SC	32	41%	28%	75%	9%	31%	28%	47%	0
	UWGB	2981	26%	48%	56%	19%	56%	22%	54%	13%

Table 9. Rating services and resources (A = 4, B = 3, etc.)	Unit of Analysis	2007-2011		
		n	A or B	mean
Library services (hours, staff, facilities)	COM SC	25	96%	3.5
	UWGB	2566	91%	3.4
Library collection (books, online databases)	COM SC	25	76%	3.3
	UWGB	2528	88%	3.3
Admission Office	COM SC	25	88%	3.4
	UWGB	2353	92%	3.4
Financial Aid Office	COM SC	21	76%	3.1
	UWGB	2136	86%	3.3
Bursar' s Office	COM SC	31	90%	3.5
	UWGB	2819	88%	3.3
Career Services	COM SC	20	65%	2.9
	UWGB	1686	84%	3.3
Academic Advising Office	COM SC	22	55%	2.5
	UWGB	2176	75%	3.0
Student Health Services	COM SC	11	91%	3.5

Table 9. Rating services and resources

(A = 4, B = 3, etc.)

	Unit of Analysis	2007-2011		
		n	A or B	mean
	UWGB	1587	88%	3.4
Registrar's Office	COM SC	29	93%	3.6
	UWGB	2645	92%	3.5
Writing Center	COM SC	4	100%	3.8
	UWGB	1071	82%	3.2
University Union	COM SC	30	90%	3.3
	UWGB	2445	86%	3.3
Student Life	COM SC	13	85%	3.1
	UWGB	1456	82%	3.2
Counseling Center	COM SC	5	80%	3.4
	UWGB	576	77%	3.1
Computer Facilities (labs, hardware, software)	COM SC	31	90%	3.4
	UWGB	2646	94%	3.5
Computer Services (hours, staff, training)	COM SC	27	93%	3.6
	UWGB	2447	92%	3.5
Kress Events Center	COM SC	20	75%	3.2

Table 9. Rating services and resources (A = 4, B = 3, etc.)	Unit of Analysis	2007-2011		
		n	A or B	mean
	UWGB	1913	90%	3.5
American Intercultural Center	COM SC	3	100%	3.7
	UWGB	348	85%	3.3
International Center	COM SC	2	100%	3.0
	UWGB	427	81%	3.1
Residence Life	COM SC	11	64%	2.6
	UWGB	1284	74%	2.9
Dining Services	COM SC	24	54%	2.5
	UWGB	2130	51%	2.4
Bookstore	COM SC	32	63%	2.7
	UWGB	2871	77%	3.0

2. Current Catalog description

Computer Science

Disciplinary Major or Minor

Interdisciplinary Major

(Bachelor of Science)

Associate Professors – Forrest B. Baulieu, Peter Breznay (chair), Hosung Song

Lecturer – vacant

The field of computer science is undergoing great changes as technology advances and the need for computer software increases. Students entering this field must not see a bachelor's degree in computer science as the culmination of study in the field. Rather, they must see it as the first step in a continuing education process that will last as long as they choose to stay in the field. The goal of the Computer Science major is to provide students with a strong foundation upon which they can continue to build as the field changes. Students can receive instruction in areas such as software design and project management, object-oriented programming, design of algorithms, operating systems, database management systems, neural networks, computer graphics, network programming, and more.

Computer science courses are often mistaken for programming courses. In reality, they require much more than learning and mastering a programming language. The heart of software design is not the language, but the ability to define a problem, analyze various components, and project and evaluate potential solutions, all of which must be scalable and robust. This must also be done under the constraint that they are subject to limitations and constraints inherent in a given computer. Students must understand that in industry there must be more than just a working program. Good software must not only work but must be fully documented, clearly written, easily modifiable to meet changing and more extensive requirements, and engineered for stability, security, and correctness.

Equally important, the program provides a theoretical base for computer science and helps students understand there is more to computer science than software development. Students develop skills they can use upon graduation but they must be prepared to enter a field which is both diverse and rapidly changing and they must be able to adapt to new technologies. This requires a solid theoretical foundation with knowledge of how computers work and how they carry out tasks specified in applications software. It requires that students think beyond writing software and explore areas such as neural networks, computer graphics, algorithm analysis, or scientific applications. This knowledge is an important ingredient to professional development as it gives them the tools they need to analyze efficiency and evaluate various programming and data design options and to see the possible futures as computer science evolves. Simply providing them with skills necessary to enter the computing profession is not sufficient. Each student must be prepared to apply what he or she has learned in order to adapt to the inevitable changes that will occur. Each must also have the ability to learn new ideas and apply them.

Graduates of the Computer Science program are prepared to continue their education at the graduate level or to apply for entry-level positions in industry. Typical entry-level jobs are programmer or programmer/analyst positions.

Students majoring in Computer Science have two options. The first is the disciplinary track and is designed for those interested in pursuing careers in fields such as software development immediately after graduation. It has an emphasis on core computer science topics including fundamental theory and software engineering. Students choosing this track must also choose a minor from the list of interdisciplinary minors offered by the University. The most common choices are Information Sciences and Business Administration but there are other options. The second track is an interdisciplinary track combining Computer Science and Mathematics courses. It is designed to help students understand some of the more complex principles that form the foundation of topics such as algorithm analysis, number systems, coding, formal language, and encryption. Although it also serves students who are career bound after graduation, those students with interest in pursuing graduate studies in computer science are strongly encouraged to choose this track. Students taking this track are not required to choose an interdisciplinary minor.

All registered students have access to the University's computing facilities. Student accounts allow students to access a wide variety of both PC-compatible and Macintosh computers, Linux and database servers (for select courses), various software developer environments, and of course the internet. Also, because of the department's participation in the Microsoft Academic Alliance, those enrolled in Computer Science courses are also entitled to home-use rights for a variety of Microsoft products. Labs are open seven days per week and are staffed by consultants who provide assistance in using the facilities. Classrooms also have network connections which allow demonstrations of software and internet applications to be integrated with classroom lectures. There is also a Computer Science teaching lab with 28 workstations and display facilities that support Computer Science instruction.

Computer Science courses have a strict prerequisite structure. It is imperative that students learn what courses are prerequisites for others and when they are offered. Students are strongly encouraged to talk to an adviser very early in their college career.

2. AAC and Dean's conclusions and recommendations from last program review

UNIVERSITY of WISCONSIN
GREEN BAY

3 April 2006

To: Fergus Hughes, Dean Liberal Arts and Science
From: John M. Lyon, Chair, Academic Affairs Council
Subject: Computer Science Self-Study Review

The AAC has reviewed the Self-Study materials submitted by the Computer Science department. The documentation submitted was considered to be well written and complete. The AAC offers the following analysis and recommendations regarding the program.

The computer science curriculum has undergone significant changes since its last self-study. The evolution of computer hardware and software during the five years since the last self-study has been significant. The development of the Internet and the hardware to support it has changed the way most computer users use their machines. The development of the graphical user interface and object oriented programming has changed the way most computer programs are written. To stay current, the computer science program has had to continuously update and modify its curriculum and the resources needed to deliver it. The self-study document presents the significant changes that have been made to 10 of the 18 courses in the computer science major over the past five years. Few programs are faced with the need to revise over half of the courses in its curriculum over a five-year period. In the case of the computer science curriculum, the prospect is that significant revisions in the curriculum will continue to be necessary over the next five years in order to maintain the quality of the major. The program has also added an interdisciplinary track to the major. This track requires a minimum of 39 credits at the upper level and integrates the study of computer science and mathematics. This track in the major should be attractive to students who previously could not combine the disciplinary computer science major with a second major or a minor in mathematics due to the need to also complete an interdisciplinary major or minor. The difficulty of completing all three programs within a reasonable time period was identified in the self-study as a factor that could be contributing to 18% of the respondents of the alumni survey and 31% of the graduating senior survey stating that they would complete the same major at a different university if they could start over. Overall, the AAC is very satisfied with the work of the computer science faculty to maintain a high quality curriculum.

The computer science faculty has also undergone significant changes over the past five years. Two new faculty members, one lecturer and one assistant professor, have been hired into the five-person program. The new faculty members have continued the tradition of the computer science faculty members to be active in both departmental and all university service.

The number of declared majors in computer science has dropped significantly from the Spring 2001 high of 173. The rapid increase in enrollments in computer science

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programs during the late 90's, followed by a rapid decrease over the past 5 years is a nation-wide trend and can be attributed to the "dot.com" boom of the late 90's followed by its bust shortly afterward. The AAC encourages the computer science faculty to strive to stabilize the enrollment in their program at a level that is sustainable both internally and externally. Highly trained professionals in the various aspects of computer science should continue to be in demand in the region for the foreseeable future. This combined with the fact that our computer science alumni report above average salaries with respect to their peers should continue to make the computer science major an attractive program of study at UWGB. A threat to this scenario is the increase in the practice of out-sourcing computer science jobs. To combat this practice on a local level the computer science department needs to maintain strong relationships with regional employers of computer science graduates and to continue to provide services to these clients after the placement of a graduate. The computer science internship program is one way to develop connections and to maintain relationships with local employers. The AAC encourages the computer science faculty to use this resource to its fullest extent. The computer science program and the university as a whole should also recognize that the competition to train students for these careers in this region is also expected to increase. The AAC believes that the computer science program should strive to be considered the premier computer science program in the region and that the university should support this goal in any way that it can.

The assessment program used by the computer science program seems to be working as intended. The department has identified weaknesses in the development of their students and has enacted curricular changes to address the problems. The AAC encourages the computer science faculty to continue to use their assessment program to identify ways to strengthen the curriculum.

The computer science program has a number of special needs that must be addressed. The first issue is the continued maintenance of the computer science laboratory. In order for the computer science curriculum to stay current and relevant, the hardware and software of this laboratory must be kept current. The AAC encourages the university to commit laboratory modernization funds to maintain this facility. The faculty members of the computer science discipline have also received a yearly one-course reassignment and a notebook computer to assist them in maintaining their curriculum. The AAC believes that this level of support for the faculty is appropriate when the program requires the level of continued curricular development that the computer science curriculum does.

cc: William Shay, Chair of Computer Science
Tim Meyer, Chair of Information and Computing Science
Tim Sewall, Associate Provost for Academic Affairs

UNIVERSITY of WISCONSIN
GREEN BAY

Date: August 22, 2006

To: Sue Hammersmith
Provost and Vice Chancellor for Academic Affairs

From: Fergus Hughes
Interim Dean of Liberal Arts and Sciences

Re: Report on the Computer Science Program Review

I have examined the Self-Study Report prepared by the Computer Science Program, as well as the review that was conducted by the Academic Affairs Council. I recommend that the Computer Science Program be continued and I offer the following recommendations for program development:

1. Computer Science majors are over 90% male. I recommend that, considering the gender imbalance, the faculty should be particularly sensitive to opportunities to attract additional female declared majors, including advising sessions for potential female students or a talk on "Women in Computer Science".
2. There has been a significant decline in the past ten years (from high to medium) in the level of satisfaction of graduating seniors. I recommend that the Computer Science faculty examine the reasons for the decline in satisfaction to determine if it is related in any way to a decline by over 30% in the number of declared majors in the past ten years.
3. I recommend that the Computer Science faculty begin discussions of the possibility that their program could become an interdisciplinary budget Unit within Liberal Arts and Sciences. The curriculum is unique in that it requires constant revision and the budgetary needs are unique in that costs of instruction are higher than almost every other Unit in Liberal Arts and Sciences. In addition, I believe that Computer Science shares more of the characteristics of an interdisciplinary program than a discipline.

cc: Associate Provost Tim Sewall

CONNECTING LEARNING TO LIFE

Office of the Dean of Liberal Arts and Sciences, Theatre Hall 335, 2420 Nicolet Drive, Green Bay, Wisconsin 54311-7001
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3. Student Learning Outcomes

The Computer Science Program has established the following Student Learning Outcomes. These learning outcomes have not changed and reactions to previous reviews have not questioned them.

1. Students must be able to design the logic and information structures necessary to create software capable of solving problems subject to specified constraints.
2. Students must develop both written and verbal communications skills that support the design and documentation of software products and help utilities.
3. Be able to analyze software to determine correctness and, if incorrect, be able to determine the cause of errors and fix them.
4. Students must understand fundamental principles and theory of both computer hardware and software and the mathematical foundations on which Computer Science is built.

4. Methods used to evaluate the achievement of outcomes

The following assessment methods have been used by the Computer Science program:

• Alumni surveys: In addition to the surveys sent out from Assessment and Testing Services we also produce our own alumni survey with specific questions that relate to our outcomes and our effectiveness at preparing students for life after college. Since the majority of our students are career bound, one of the program's goals is to provide them with the knowledge necessary to enter a dynamic profession and continue to learn as their profession and technology evolves. As such, we believe that alumni surveys allow our graduates to do some self reflection, evaluate their experiences from a perspective not available to them as students, and provide us feedback on whether we have been able to help them achieve their goals and function in a professional environment.

• Internships: We believe course content should not only teach students specific facts and concepts but should also teach them to become independent learners. Through an internship, a student is placed into an environment in which there is no dependence on a faculty member or sympathetic students willing to provide assistance with their software. He or she is expected to pick up certain abilities quickly and be productive in their use. At the end of each internship, each student must submit a term paper and his or her supervisor must provide an evaluation of the intern to the faculty member supervising the internship.

• Capstone Essay: As with the internship, the capstone essay provides the student an opportunity to demonstrate that he or she is capable of independent thought and work. Since we cannot guarantee that

each student will get an internship we needed another tool that allows a student to demonstrate this ability. This is done by having each student perform an investigative study of some field in computer science and write a term paper or software project which will demonstrate their ability to independent work or research.

• Embedded Assessment: specific abilities are tested via examination and the ability to get a project designed, debugged, and running. Two required courses (COMP SCI 331 and COMP SCI 372) and several elective courses (COMP SCI 352, COMP SCI 451, COMP SCI 460) each require large scale group or individual projects. Students are expected to design a particular system from scratch, build it, deal with inevitable errors in the design or ones that get coded into the software, and eventually get it running. Furthermore, these systems must be fully documented and, in some cases, user manuals must be written. The students' ability to accomplish these goals tells us a lot about their ability to write, create software, and deal with software bugs. The following tables list the working skills course by course.

Skill (at working level)	241	242	256	257	331	351
Procedural programming			X		X	
OOD, small projects			X	X	X	
OOD, complex projects				X		
Coding, Java			X	X		
Coding, machine language and Assembly						
Coding, other language					X	
Implementation of simple data structures				X		X
Implementation of complex data structures						X
Analysis of efficiency				X		X
User interface design, graphics				X	X	
Internet programming					X	
Use of databases					X	
Design and implementation of databases					X	
Management of large projects					X	
Elements of systems analysis						
Problem solving with a computer				X		X
Networking design and implementation						
Computer hardware						
Logical reasoning in problem solving	X	X				
Elements of artificial Intelligence						
Algorithm design for problem solving		X		X		X
Code testing and documentation			X	X	X	

Parallel processing						
Mathematics for databases and data analysis						

Skill (at working level)	352	353	372	450	464
Procedural programming		X			
OOD, small projects			X		
OOD, complex projects	X		X		
Coding, Java					
Coding, machine language and Assembly		X			
Coding, other language	X	X	X		
Implementation of simple data structures	X		X		
Implementation of complex data structures					
Analysis of efficiency				X	
User interface design, graphics	X		X		
Internet programming					
Use of databases			X		X
Design and implementation of databases			X		
Management of large projects					X
Elements of systems analysis			X		X
Problem solving with a computer	X		X	X	X
Networking design and implementation					
Computer hardware		X			
Logical reasoning in problem solving				X	
Elements of artificial Intelligence					
Algorithm design for problem solving	X			X	
Code testing and documentation			X		
Parallel processing					
Mathematics for databases and data analysis			X		

Conclusions:

Not all of the assessment methods have proven to be equally worthwhile for improving the program. Reactions from graduating seniors and alumni have led to changes in the past. The program has used a senior roundtable (essentially a pizza party) for several years. This may not have the rigor of more formal alumni surveys or exit interviews, but it has provided reasons to

change. The embedded assessments have not been continued. They may have documented learning but they have not revealed anything the faculty did not already know. If the forthcoming University Assessment Plan mandates embedded assessment, the mechanisms used in the previous review can be resurrected, but in our experience they have not led to change. The internships and capstone essay will continue as assessment tools. The general pattern of responses from internship supervisors shows that the supervisors may be easier to satisfy than faculty but that still reflects program quality. If the aim of assessment is not necessarily program improvement but simply demonstration of learning, the faculty believe that the success of the graduates provides the most compelling evidence. We await either the University Assessment Plan or reaction to this program review to learn what is an acceptable assessment plan.

5. *Timeline for the implementation of assessment methods*

The assessment process is embedded in the teaching and curriculum development work performed by the Computer Science faculty on an on-going basis. Additional methods of assessments will be developed and performed contingent upon the publication of the details of the new annual assessment requirement.

6. *Those responsible for coordinating data collection*

All Computer Science faculty, coordinated by the Program Chair, are responsible for assessment data collection. Since currently only two full-time faculty are part of the program, newly hired faculty need to be educated and trained in order to enable them to fully participate in the assessment process.